

Once Upon a Graph

2

Analyzing the Characteristics of Graphs of Relationships

WARM UP

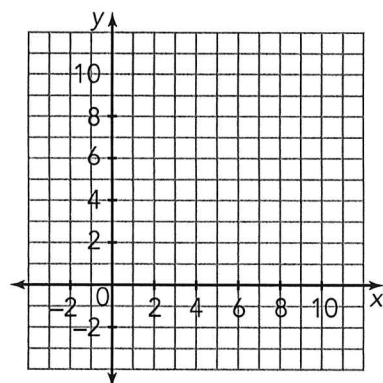
Consider the sequence 4, 6, 8, 10.

1. Use the table to list each term of the sequence.

Term Number				
Term				

2. Use the chart to write each of the terms as an ordered pair.

3. Graph the sequence on the coordinate plane.



LEARNING GOALS

- Describe qualitatively the relationship between two quantities by analyzing a graph.
- Describe characteristics of graphs using mathematical terminology.
- Describe a real-world situation that could be represented by a given graph.
- Sketch a graph of a relationship between quantities given a verbal description.

KEY TERMS

- discrete
- continuous
- collinear points
- non-linear

You have analyzed the graphs of linear relationships. What other ways are there to describe the relationship between two quantities? How can you analyze non-linear graphs?



Getting Started

Graph Sort

1. Cut out the 12 graphs at the end of the lesson. Sort the graphs in any way you want. Explain how you sorted the graphs.



Identifying Characteristics of Graphs



dots

A **discrete** graph is a graph of isolated points. The values between each point on a discrete graph are not a part of the relationship. A **continuous** graph is a graph with no breaks in it. All the points in a continuous graph can be a part of the relationship.

Connected with a line →

1. Are the graphs of sequences discrete or continuous?

Explain your reasoning.

Discrete - they always have points that are isolated or separate. (And all the points in between are not represented.)

2. Sort the graphs you cut out into two groups: those graphs that are discrete and those graphs that are continuous. Use the letter of each graph to record your findings.

Discrete Graphs	Continuous Graphs
A, F, J	B, C, D, E, G, H, I, K, L

3. Sort the graphs into four groups: those that are increasing, those that are decreasing, those that are both increasing and decreasing, and those that are neither increasing nor decreasing. Use the letter of each graph to record your findings.

Increasing	Decreasing	Both Increasing and Decreasing	Neither Increasing nor Decreasing
A, B	E, K	C, D, H, I, L	F, G, J

Remember that when you are determining whether a graph is increasing or decreasing, you analyze the graph from left to right.

Collinear points are points that lie in the same straight line.

A linear graph is a graph that is a line or a series of *collinear points*. A **non-linear** graph is a graph that is not a line and therefore not a series of collinear points.

4. Sort the graphs into two groups: those that are linear and those that are non-linear. Use the letter of each graph to record your findings.

Linear Graph	Non-linear Graph
A, B, F, G, K	C, D, E, H I, J, L

Keep your graphs. You will use them again in the next lesson.

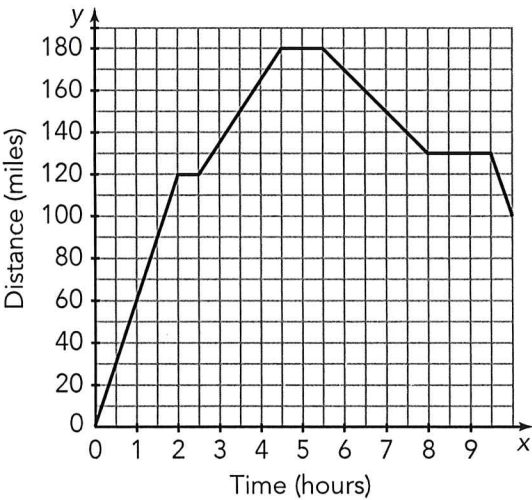
ACTIVITY
2.2

Interpreting Graphs

How can you tell by looking at the graph when Greg was traveling the fastest?



The graph shown represents Greg's distance from home after driving for x hours.



1. Analyze the graph between 0 and 2 hours.

a. How far from home was Greg after driving for 2 hours?

Greg was 120 miles from home after 2 hours of driving.

b. How fast did Greg drive during this time? Explain your reasoning.

Greg was traveling 60mph. $\frac{120 \text{ miles}}{2 \text{ hr}} = 60 \text{ mph}$

c. How do you know that Greg traveled at the same rate for the first two hours? Describe in terms of the graph.

The graph is increasing at the same rate. The graph is a straight line.

2. Analyze the graph between 2 and 2.5 hours.

a. How far did Greg travel from home between 2 and 2.5 hours?

Greg did not travel any miles from home between 2 & 2.5 hours.

b. How fast did he travel during this time? Explain your reasoning.

Greg traveled 0mph - he was stopped.

The graph is a flat line so time is passing but his distance is not changing.

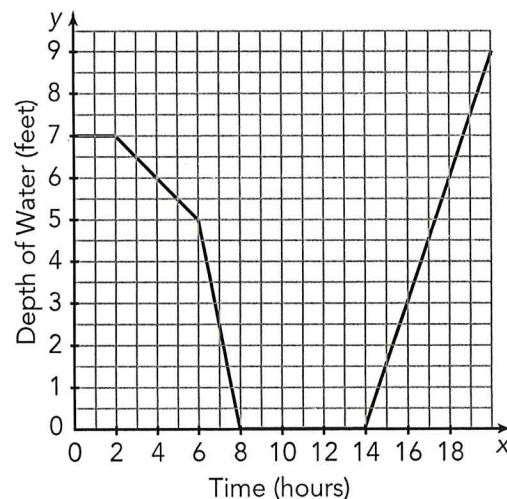
c. Describe the shape of the graph between 2 and 2.5 hours.

The graph is a horizontal line.

3. Label each segment of the graph with letters A through G, beginning from the left. Record in the table the time interval for each segment. Then, describe the distance Greg traveled, in what direction, and at what rate.

Segment	Time Interval (hours)	Description of Greg's Trip
A	0 to 2	Greg traveled 120 miles from home at a rate of 60 mph.
B	2 to 2.5	Greg took a half-hour break when he was 120 miles from home.
C	2.5 to 4.5	Greg traveled 60 more miles. $\frac{60}{2} = 30 \text{ mph}$
D	4.5 to 5.5	Greg took a 1 hour break when he was 180 miles from home.
E	5.5 to 8	Greg traveled 50 miles <u>towards</u> home at a rate of 20 mph. $\frac{50}{2.5} = 20 \text{ mph}$
F	8 to 9.5	Greg took a 1½ hour break when he was 130 miles from home.
G	9.5 to 10	Greg traveled 30 miles <u>towards</u> home at 60 mph. $\frac{30}{.5} = 60$

4. The crew at the community swimming pool prepared the pool for opening day. The graph shows the depth of water in the swimming pool after x hours.



- a. Why do you think the pool was emptied and then refilled?

Repairs

- b. Label each segment of the graph with letters A through E, beginning from the left. Record in the table the time interval for each segment. Then, describe how fast the water level in the pool changed and whether it was being drained or filled.

Segment	Time Interval (hours)	Description of the Water in the Pool
A	0 to 2	The water in the pool remained 7 ft. deep.
B	2 to 6	The pool was being drained at a rate of -0.5 ft/hr . At the end of the 4th hour the water level was 5 ft.
C	6 to 8	The pool was being drained at a rate of -2.5 ft/hr . At the end of the 8th hour the depth was 0 ft.
D	8 to 14	The pool remained empty for 6 hours. (Repairs)
E	14 to 20	The pool was being filled at a rate of 1.5 ft/hr . At the end of the 20th hour the depth was 9 ft.

- c. Was the pool being emptied at the same rate the entire time? Explain using mathematics and the graph.

No - it was being drained at -0.5 ft/hr & then -2.5 ft/hr .
It's not a straight line so the rate wasn't the same the entire time.

- d. Why does it make sense for the graph of this situation to be continuous rather than discrete?

The water goes out continuously - it's not pulled out by giant buckets.
At any given time, the water level is slightly different.

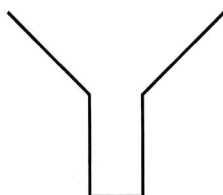
ACTIVITY
2.3

Identifying Graphs Based on Qualitative Descriptions

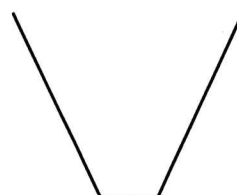


Students at East High School are designing ceramic drinking cups for an art project. The students chose a variety of different shapes for their cups. Six of these shapes are shown.

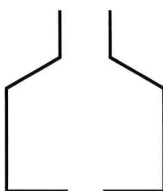
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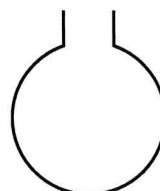
Jacquelyn



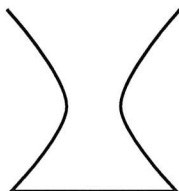
Ryan



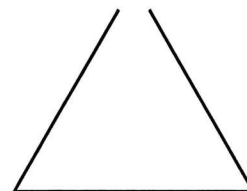
Timothy



Monica



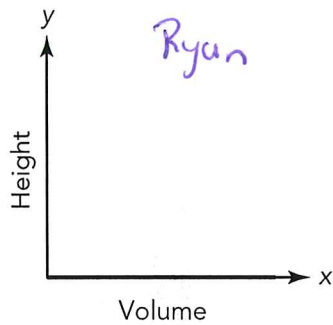
Niko



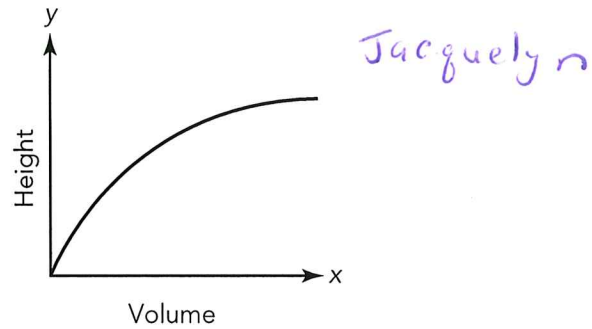
To test the cups, hot water is poured into each at a constant rate. The graphs shown represent the height of the liquid in each cup as the volume changes.

1. Match each cup to its graph. Explain the strategy or strategies you used to match each cup correctly to its graph.

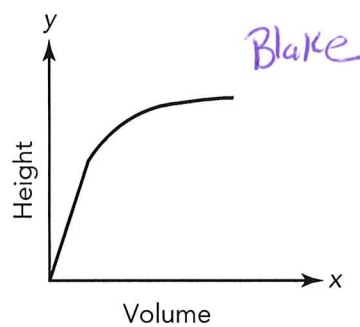
Graph A



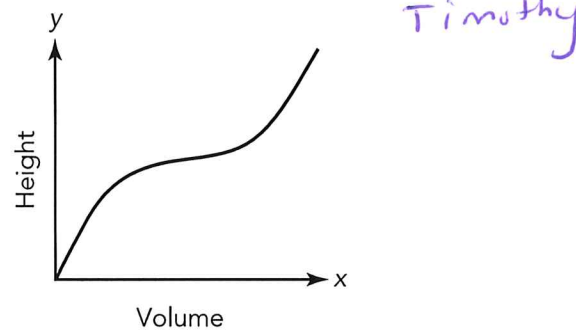
Graph B



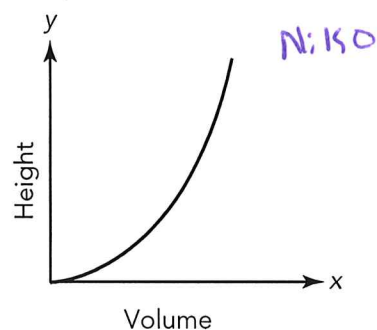
Graph C



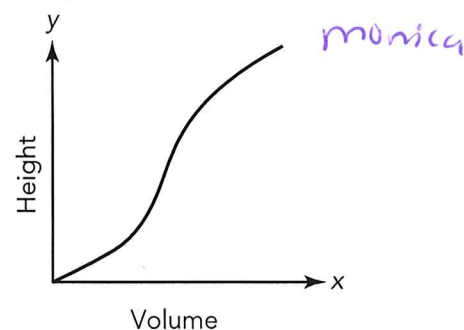
Graph D



Graph E



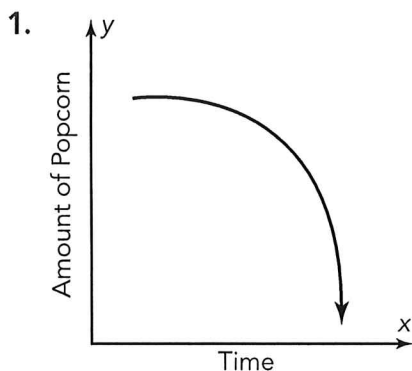
Graph F

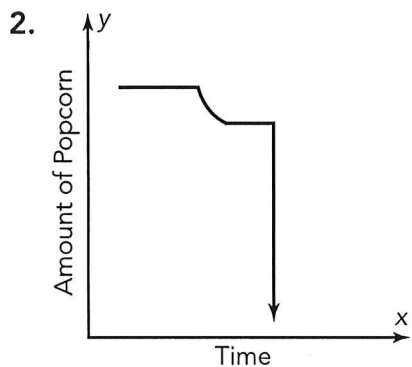


TALK the TALK

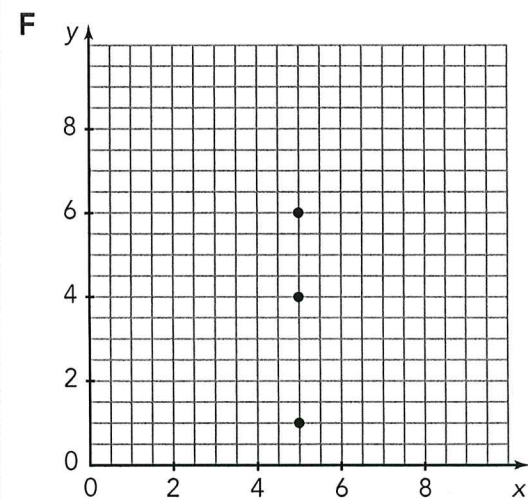
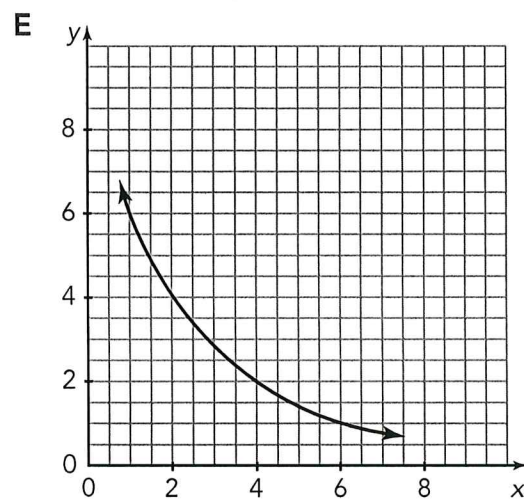
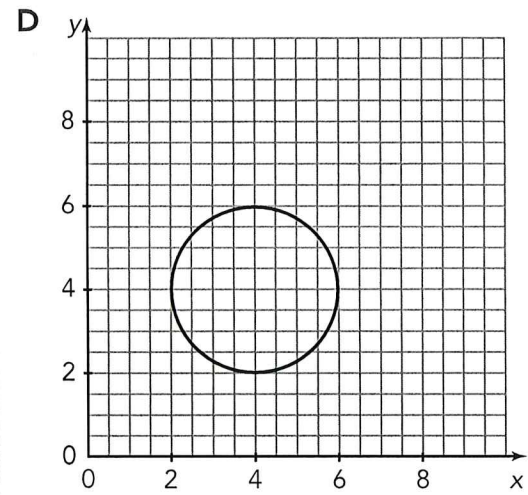
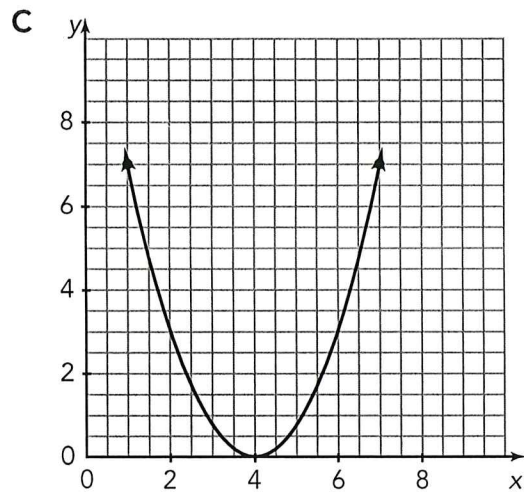
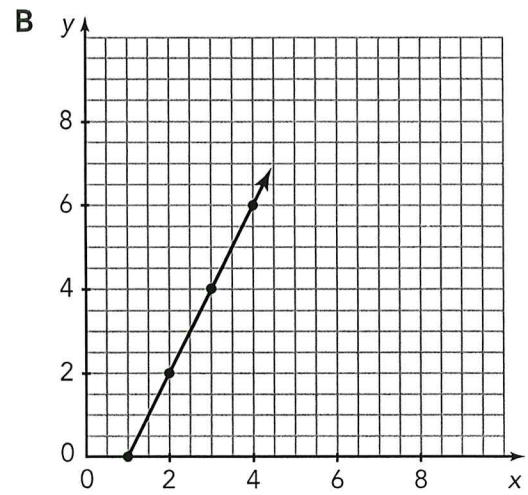
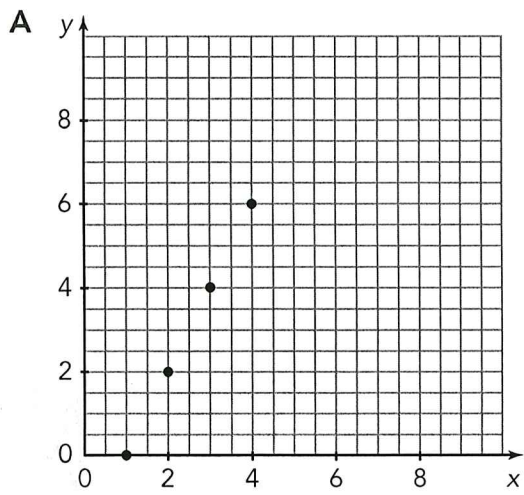
Popcorn at the Movies

You and a friend go to the movies and decide to share a large bucket of popcorn. Write a story to describe each graph.

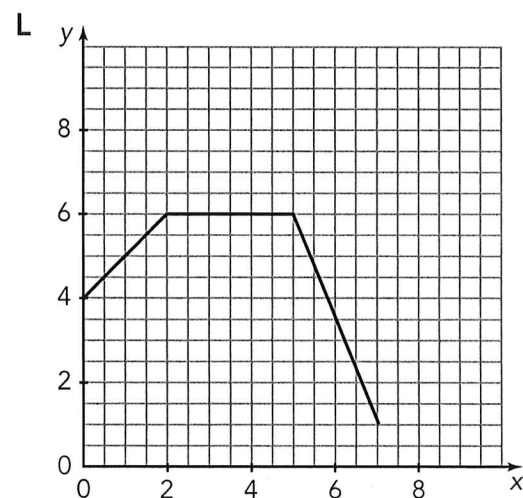
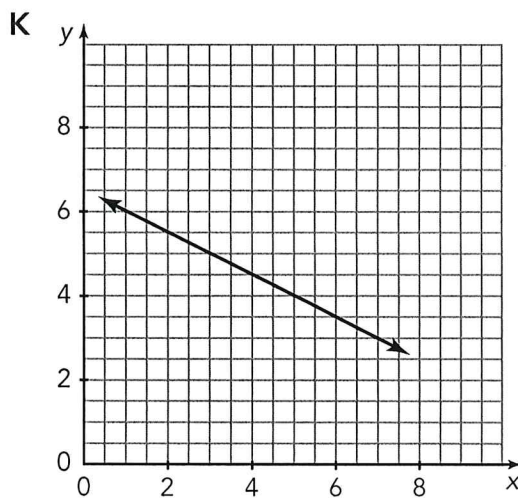
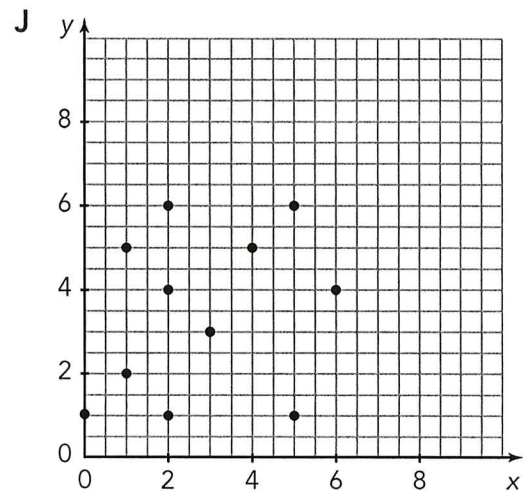
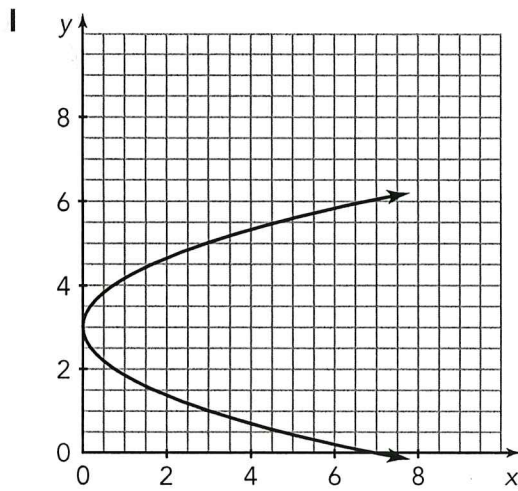
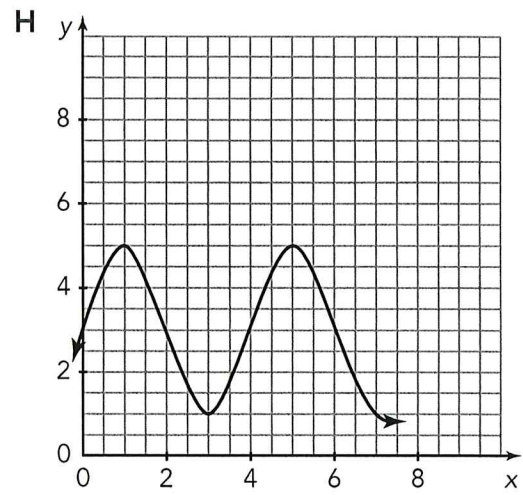
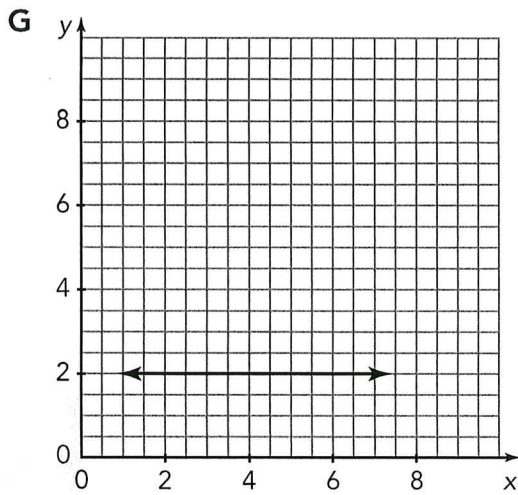




Graph Cutouts



Graph Cutouts



Assignment

Write

Explain the difference between each set of terms.

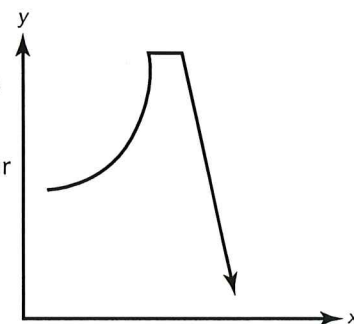
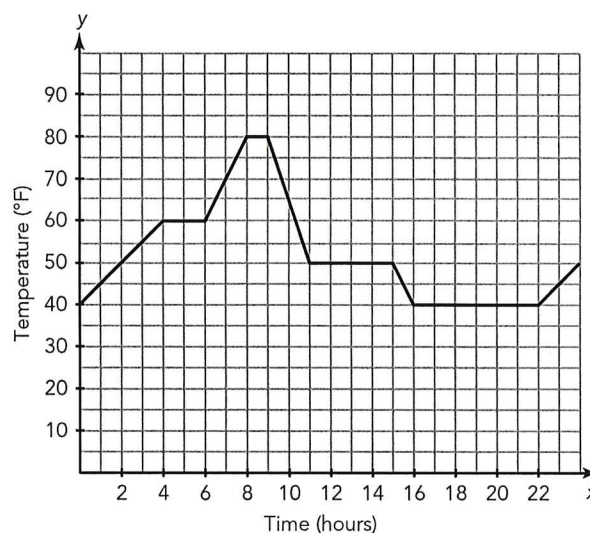
1. a continuous graph and a discrete graph
2. a linear graph and a non-linear graph

Remember

The graph of a relationship has meaning because it shows how the dependent quantity changes as the independent quantity changes.

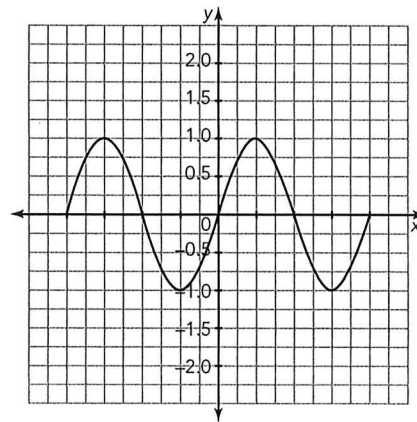
Practice

1. Grant is recording the hourly temperatures of Grove City for a science project. He starts at 8:00 AM and records the temperature each hour for 24 hours. The graph represents the temperature of the city x hours after 8:00 AM.
 - a. Is this graph discrete or continuous? Is the graph increasing, decreasing, or both increasing and decreasing? Is the graph linear or non-linear? Explain.
 - b. What was the temperature of Grove City at 8:00 AM? What was the temperature of Grove City at noon?
 - c. Did the temperature change at a constant rate from 8:00 AM to noon? Describe the change in terms of the graph.
 - d. What was the rate of change of the temperature between 8:00 am and noon?
 - e. How much did the temperature change from noon to 2:00 PM? What was the rate of temperature change from noon to 2:00 PM?
 - f. What is the shape of the graph during the time from noon to 2:00 PM?
 - g. Label each segment of the graph with letters A through I beginning from the left. Create a table to record the time interval for each segment. Then describe whether the temperature was increasing or decreasing, the rate of change, and the final temperature of the time interval.
 - h. Why does it make sense for the graph of this situation to be continuous rather than discrete?
2. Grant's teacher gave the students the graph of temperatures for a 24-hour period in a different city. Write a story to describe the graph.



Stretch

Create a situation with an independent and dependent quantity that could match the graph shown.



Review

1. Describe the pattern in each sequence and determine the next term of the sequence.

a. A, C, E, G, . . .

b. 4, 13, 22, 31, . . .

2. Geoff is training for a charity bike ride. He takes a ride on 49-Mile Scenic Drive in San Francisco. The table shows his time at the beginning and end of the ride. What is Geoff's average speed for the ride?

Time (hours)	Distance (miles)
0	0
3.5	49

3. School event committee members are designing banners for a school dance. They are experimenting by drawing different-sized rectangles. In each rectangle, the width is $\frac{1}{4}$ the length. Complete the table for rectangles with the given lengths.

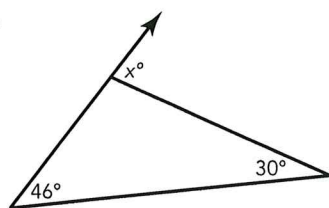
Length (inches)	4	8	12	16	20
Width (inches)					
Area (square inches)					

a. Write the ordered pairs from the table, using area as the dependent variable and length as the independent variable.

b. Is the relationship between the length and the area linear? Explain your reasoning.

4. In each figure, solve for x .

a.



b.

